Flood Risk Statement and Drainage Impact Assessment

Dunmill Battery Energy Storage System

Ref	05104-6669574

Revision History

Issue	Date	Name	Latest changes
01	04/01/2024	Antonis Poulakis	First created
02	17/01/2024	Antonis Poulakis	Minor text changes

Contents

1 Overview

1.1 Introduction

Dunmill BESS is a proposed battery energy storage system (BESS) located at Bridge of Dun, Angus in Scotland. The capacity of the proposed storage system facility is to be 49.9MW.

This report sets out the flood risk screening and surface water management plan for the proposed Dunmill battery energy storage system, which will comprise of 32 battery storage enclosures (BSEs), associated foundations, transformers, power conversion systems (PCSs), electrical infrastructure, access track, crane hardstanding, and spares storage containers.

Drawing 05104-RES-LAY-DR-PT-001 included in ***Appendix A***, shows the proposed project layout. The compound area within the fence measures 0.83 hectares, the total area enclosed by the red line boundary is approximately 3.69 hectares.

Relevant compliance documentation is included in ***Appendix E***.

2 Relevant Guidance and Legislation Requirements

This report uses best practice and conforms with the requirements of the relevant regulatory authorities.

The key legislation and guidance adhered to are as follows:

- Angus Council Technical Guidance for Developers and Regulators: Flood Risk and Surface Water Drainage Requirements[1] (Sep 2023).
- National Planning Framework (NPF) 4[2].
- Angul Local Development Plan – Strategic Flood Risk Assessment (2015)[3].
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011.
- SEPA "Flood Modelling Guidance for Responsible Authorities" Version 1.1.
- SEPA "Surface water flooding summary: Methodology and mapping", October 2022.
- Guidance for Pollution Prevention (GPP).
- The Sustainable Urban Drainage Scottish Working Party (SuDSWP) Water Assessment and Drainage Assessment Guide.
- Control of water pollution from construction sites. Guidance for consultants and contractors (C532), 2001.
- C753: The SuDS Manual, December 2015.
- Sewers for Scotland 4th edition Scottish Water, Scottish Water, October 2018.
- Standard advice notes and process guidance: Surface Water Policy, Scottish Water.
- Local Development Plan Policy PV15: Drainage Infrastructure.
- Technical Flood Risk Guidance for Stakeholders, SEPA, June 2022.
- Climate Change Allowances for Flood Risk Assessment in Land Use Planning, SEPA, April 2023.
- Flood Risk and Land Use Vulnerability Guidance, SEPA, July 2018.
- SEPA planning information note 4: Position on Development Protected by a Flood Protection Scheme, July 2018.
- Flood Risk Standing Advice for Planning Authorities and Developers, SEPA, November 2020.
- Position statement on elevated buildings in areas of flood risk, SEPA, November 2020.

[1] https://www.angus.gov.uk/sites/default/files/2023-09/Technical%20Guidance%20for%20Developers%20and%20Regulators%20-%20Flood%20Risk%20and%20Surface%20Water%20Drainage%20Requirements.pdf
[2] https://www.gov.scot/publications/national-planning-framework-4/
[3] https://www.angus.gov.uk/sites/default/files/Strategic%20flood%20risk%20assessment.pdf

- Local Development Plan Policy PV12: Managing Flood Risk.
- Strategic Flood Risk Assessment (SFRA), Angus Council, February 2015.
- Local Flood Risk Management Plan: Tay Estuary and Montrose Basin, Angus Council, June 2016.
- Bathing Waters (Scotland) Regulations 2008.
- The EU Water Framework Directive (2000/60/EC).
- British Geological Survey (BGS) Maps.

The preliminary drainage design will ensure that the following requirements of Angus Council's Technical Guidance for Developers and Regulators: Flood Risk and Surface Water Drainage Requirements (Sep 2023) are met.

- Surface water drainage must be discharged by means of a Sustainable Drainage System (SuDS).
- Development water drainage will meet the requirements of NPF4 Policy 22 items as described below:
    - Not increase the risk of surface water flooding to others, or itself at risk.
    - Manage all rain and surface water through sustainable urban drainage systems.
    - Seek to minimise the area of impermeable surface.
- A natural flood risk management including green and blue infrastructure will be in place.

3 Existing Information

3.1 Site Location

The site is located approx. 500m to the east of the Bridge of Dun Substation, which itself sits on the north-west of Bridge of Dun train station, in Montrose, Scotland. Refer to ***Appendix A*** for the Site Location Plan.

Access will be taken off Zu444-1 road to the south of the site. The access track to the site will be formed by upgrading an existing track and constructing a new track where the existing track ends.

3.2 Existing Land Use and Topography

A walkover survey of the site has been undertaken, and a topographical survey of the site extents has been carried out to confirm the existing land use and topography. The existing site land use is for agricultural purposes, confirmed by the landowner during a site walkover.

The ground levels in the location of the proposed development vary from 12.5m AOD in the northwest to 8m AOD in the southeast corner of the site, resulting in a fall of 1 in 25 across the site. The topographical survey drawing can be found in ***Appendix C***.

3.3 Ground Conditions

According to BGS data and as indicated in ***Figure 1***, the site is mostly underlain by a bedrock of sandstone, siltstone, and mudstone. The northwest of site is underlain by a bedrock of volcanic formation comprising andesite and basalt. Overlying these bedrocks are superficial deposits of sand, silt, and clay across the whole site.

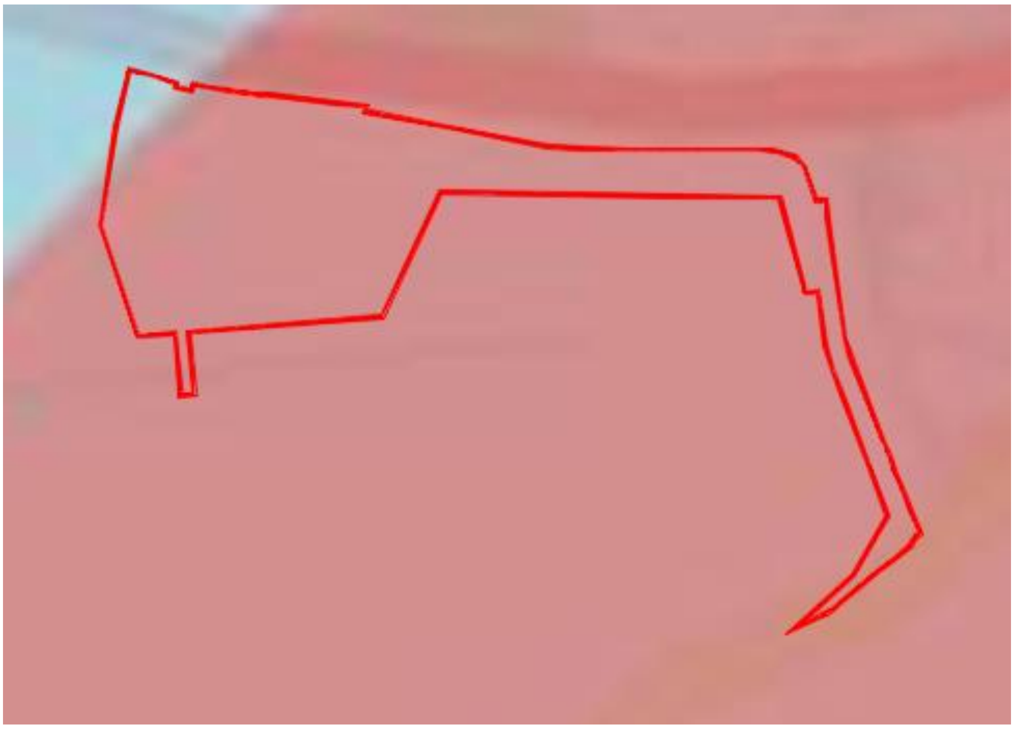

Figure 1 – Bedrock Geology (red: sandstone, siltstone, and mudstone, Ligh blue: andesite and basalt)

3.4 Existing Hydrology / Drainage

The site drains via overland flow into a ditch, which runs approx. 600m to the west towards Bridge of Dun substation. At this point, the ditch changes direction and runs in a southerly direction alongside the perimeter of the site, until the point that it turns towards the east on the north side of the Zu444-1. The watercourse crosses the Zu444-1 via a culvert and discharges into the River South Esk . At the point of discharge the River South Esk has an elevation of approximately 3m AOD.

A pre-development overland flow path drawing can be found in ***Appendix A***.

SEPA mapping classify the quality of groundwater underneath the majority of the site as ‘good’. However, the corridor on the east of the site for the potential access track sits over “poor” quality groundwater as indicated in ***Figure 2***. The site does not fall in a ‘drinking water protected area’ as defined by SEPA.

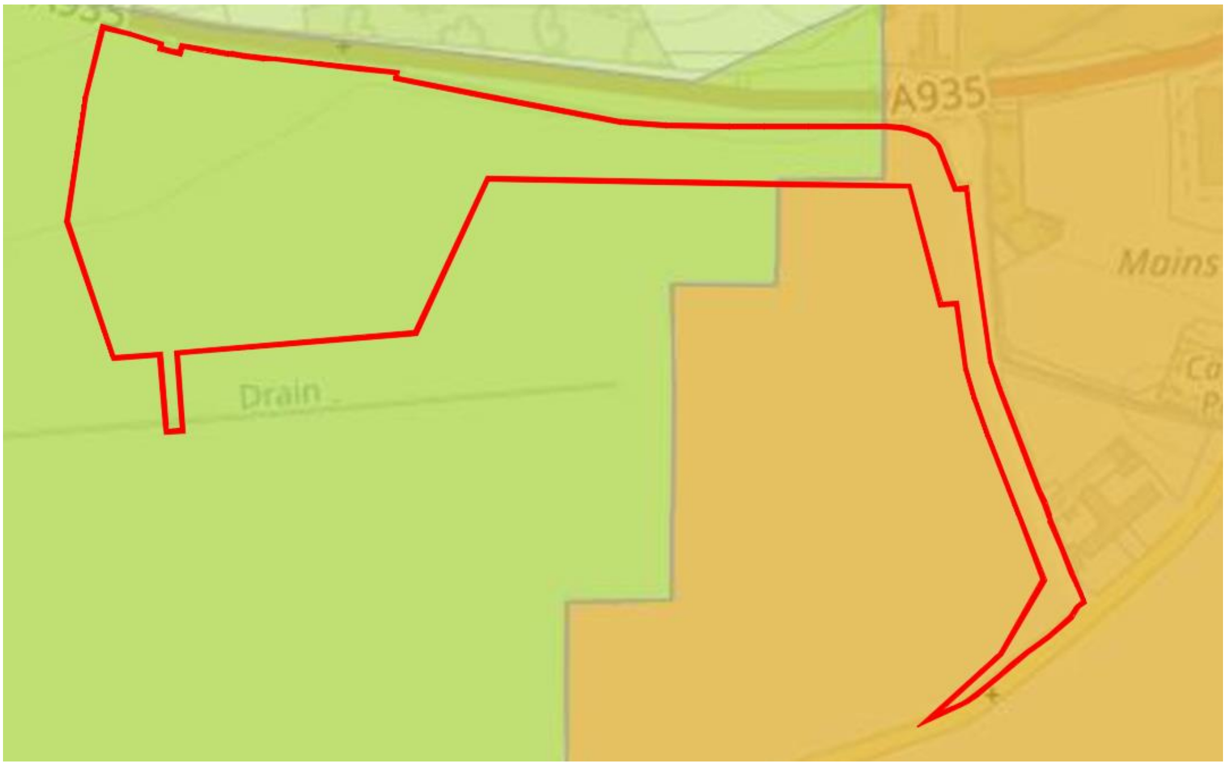

Figure 2 – Groundwater quality (green: Good, orange: Poor)

Some water ponding was observed in the adjacent fields and on the south side of site, indicating the ground on site has limited infiltration potential.

A topographical survey was undertaken in September 2023 for the proposed development, including in its extents a section of A935, Zu444 and Zu444-1. The topographical survey recorded culverts along some sections of the ditch. The topographical survey is included in ***Appendix C***.

No land drains were found in the topographic survey, which included buried services scanning, or noted by landowner during conversations.

4 Flood Risk Screening

4.1 Overview

The proposed development is deemed to be at low risk from flooding. The proposed compound area is free from any flood risk. However, part of the access track sits on an area with a 10% chance of flooding. The proposed compound location has a minimum existing elevation of 8m AOD. The 0.1% chance of flooding design level reaches approximately 6.5m AOD (based on existing ground levels in the vicinity of the design flood area). Proposed compound levels will be such that a minimum 1.5m of freeboard above the 0.1% chance of flooding design level will be achieved.

4.2 Flooding from Fluvial Sources and Surface Water

Figure 3 below illustrates the SEPA flood risk map, with the proposed site boundary overlaid. As can be observed in ***Figure 3*** the potential access corridor and the short drain corridor on the southwest lie within areas at risk of flooding from fluvial sources (light blue zone 0.1% chance of flooding, lighter blue zone 0.5% chance of flooding and dark blue zone 10% chance of flooding), or surface water (light purple zone 0.1% chance of flooding, lighter purple zone 0.5% chance of flooding and dark purple zone 10% chance of flooding). However, the location of the main battery infrastructure is free of flood risk.

Figure 3 - SEPA surface water and fluvial flood risk map, with proposed site boundary overlaid.

The design considers that wherever possible, safe access routes should be provided that are located above design flood levels and avoiding flooding flow paths. Where this is not possible, limited depths of flooding may be acceptable, provided that the proposed access is designed with appropriate signage etc to make it safe. The acceptable flood depth for safe access will vary depending on flood velocities and the risk of debris within the flood water. Even low levels of flooding can pose a risk to people in situ (because of, for example, the presence of unseen hazards and contaminants in floodwater, or the risk that people remaining may require medical attention).

Figure 4 indicates the expected flood depths on site. The light blue colour in the access corridor represents flood depths less than 300mm, with velocity less than 1m/s. Therefore, in the 10% chance of flooding event the track will still be accessible by vehicles to allow the emergency services or staff to safely reach or exit the development during flood conditions.

Therefore, flooding from fluvial sources and surface water is considered to be **low**.

Figure 4 - SEPA surface water and fluvial flood risk map, with proposed site boundary overlaid.

4.3 Flooding from Groundwater

The BGS Bedrock Aquifers dataset shows the site to be underlain by bedrock aquifers dominated by intergranular fracture flow of high productivity. However, BGS borehole records in proximity (ref: NO65NE13019/38/1) do not prove the existence of any water within 4m depth. Borehole record can be found in ***Appendix D***.

Therefore, risk of flooding from groundwater is considered to be **low**.

4.4 Flooding from Tidal or Sea Flooding

SEPA flood risk mapping shows the proposed development site does not lie in an area at risk of tidal or sea flooding. However, the site ground elevation above ordnance datum is less than 20m AOD and there are areas at risk of sea or tidal flooding in close proximity to site.

Therefore, the site has a **low** tidal and sea flood risk.

4.5 Flooding from Overland Sheet Flow

Levels within the site area are proposed to fall to the southeast at a gradient of 1 - 2%, ensuring flooding from sheet flow will not develop on the site.

The proposed development site sits near to the ridge of a local high point (roughly positioned at the Wester Dun). The Wester Dun high point sits south of A935 with only a small catchment above the proposed compound.

Therefore, the site has a **negligible** risk of flooding from overland sheet flow.

4.6 Flooding from Sewers and Highway Drains

A highway drain is in the vicinity of the development. The highway is adjacent to the north site boundary and on a higher level to the proposed development. The highway does not sit within risk flood area. Therefore, it is unlikely that the highway will drain into the site.

Therefore, the site has a **negligible** risk of flooding from sewers or highway drains.

4.7 Flooding as a Result of the Development

The discharge flow as a result of the development as set out in Sections 5 and 6 of this report, complies with all relevant local guidance and it is designed in accordance with the SuDS Manual. Therefore, the development is not considered to exacerbate the flood risk of the surrounding area.

4.8 Historic Flooding

Historically, following heavy rainfall accounts parts of the site experience standing water due to the poor infiltration of the soil. However, these areas are on the south of the site and in a safe distance from where the proposed development will be located.

5 Drainage Design Options

5.1 Foul Drainage

There will be no permanent foul drainage from the proposed development.

Any foul drainage from the temporary welfare facilities will be self-contained and disposed off-site appropriately.

5.2 Surface Water Drainage Discharge Options

5.2.1 General

As per SEPA flood risk maps, the proposed compound is free of flood risk areas excluding the proposed access track. The project is to be drained by a sustainable drainage system which allows the water to complete its circle and to return to a natural water body. This procedure contributes to enhancing blue and green networks. The SuDS Hierarchy as included in 'Water Assessment and Drainage Assessment Guide' section 3.2.3 will be applied and is described below:

- Adequate soakaway or other infiltration system
- Discharge to existing watercourse
- Discharge to sewer

Adequate infiltration testing to BRE 365 Diget will be carried out to determine the capacity of the soil infiltration and the viability of an infiltration-based drainage solution.

5.2.2 Rainwater Re-Use

Rainwater re-use is not applicable to this project; there are no facilities within the proposed development that have a demand for water.

5.2.3 Infiltration

Based on the hierarchy identified in Section 5.2.1, the preferred method of surface water discharge is via infiltration to the ground. However, the ground on site is not anticipated to support drainage by infiltration due to the following:

- Standing water observed on the ground during the site visit and historically as described by the landowner.
- Existing drainage systems in place in the field, indicating the need to convey overland flows during storm events.

5.2.4 Attenuate Rainwater in Ponds for Gradual Release

Refer to the infrastructure layout provided in ***Appendix A*** for details of the drainage layout.

If infiltration testing shows an infiltration-based drainage solution is not possible, the next preference in the SuDS Hierarchy is to attenuate flows in an on-site basin, discharging from site at a rate that does not exceed that of pre-existing greenfield conditions. Due to the low probability of infiltration capacity on site, it is assumed for design purposes that discharging to an existing watercourse through an attenuation basin is the highest option on the SuDS Hierarchy that is viable for the proposed development site.

The surface water drainage will be designed in accordance with the guidance documents in Section 2 and Section 5.2.1. Flows will be restricted to the 1 in 2-year greenfield runoff rate (Q_{med}) and the attenuation basin will be sized to contain the 1 in 200 rainfall event plus a 39% allowance for climate change.

The preferred discharge point for the restricted flow will be the drainage ditch located to the south of the proposed development. The ditch drains into River South Esk that runs approximately 500m to the south of the proposed development.

6 Development Proposal

6.1 Site Preparation

SuDS will be constructed prior to, or at the same time as the access track and compound. Interim measures such as the placement of silt fences will be retained in place until SuDS are established and providing sufficient silt removal.

As part of site preparation, existing topsoil on site will be scraped off and set aside for re-use in the landscaping scheme.

For the proposed areas of permanent hardstanding, the preferred surfacing will likely comprise compacted granular material. The compound and tracks will facilitate construction traffic and allow safe installation of the electrical infrastructure.

The compound will be graded approximately in line with existing falls, ensuring a fall within the compound will not exceed 2%.

6.2 Management of Surface Water Flows

6.2.1 Proposed SuDS

Refer to ***Appendix A*** for indicative drainage details and the layout of the SuDS proposed across the site.

The proposed attenuation basin has been designed with a plan area and depth sufficient to accommodate storm flows generated on site during a 200-year event including an additional 39% allowance for climate change. To mitigate ground stability risk and slip / trip risk, basin slopes are limited to 1:3.

Attenuation calculations are summarised in Section 7 and included in ***Appendix B***. Interception losses, such as those provided by vegetation, are neglected from these calculations as a conservative measure.

6.2.2 Extreme Event Flow Design

In accordance with CIRIA Report 753 and with Technical Guidance for Developers and Regulators: Flood Risk and Surface Water Drainage Requirements, an extreme event flow path should be considered as part of the SuDS design.

A post development extreme event flow path drawing can be found in ***Appendix A***.

The extreme event flow path will remain as per the existing scenario, i.e., over vegetation down towards the ditch and final discharge into the River South Esk south of site.

To mitigate flood risk in the event of an extreme event, the attenuation basin will be located downslope of the energy storage facility. The resultant site levels will be such that surface water from any extreme events will flow over the banks of the attenuation basin away from the energy storage facility and then downslope overland away from the site and towards the drainage ditch. The edges of the attenuation basin will be vegetated to reduce the risk of scour during an extreme event.

6.2.3 Water Quality and Treatment

In line with the requirements noted in the Angus Council Technical Guidance for Developers and Regulators: Flood Risk and Surface Water Drainage Requirements, a Simple Index Approach is undertaken to ensure the proposed drainage strategy provides adequate water quality treatment. The Simple Index Approach has been carried out in accordance with Section 26.7.1 of the SuDS Manual.

As a conservative approach, the proposed development is considered a high pollution hazard level based on land use definitions provided in Table 26.2 of the SuDS Manual. The corresponding pollution hazard indices are denoted in Table 1.

Surface water within the proposed development will receive minimum three stages of treatment before being discharged overland to the River South Esk. The three main stages are listed below:

1. Filtration of water through infiltration trench by filtration material such as graded gravel with sufficient smaller particles; mitigation indices for infiltration trench: TSS = 0.4, metals = 0.4, hydrocarbons = 0.4.

2. Settlement in attenuation / infiltration basin; mitigation indices for detention basin: TSS = 0.5, metals = 0.5, hydrocarbons = 0.6.

3. Filtration of water through vegetation within drainage ditch within field TSS = 0.5, metals = 0.6, hydrocarbons = 0.6.

Table 1 below demonstrates how the pollution hazard index for each contaminant is satisfied by the three stages of water treatment provided as part of the proposed drainage strategy.

Table 1 - Simple Index Calculation

Contaminant Type	Stage 1	Stage 2	Stage 3	Total SUDS Mitigation Index	Pollution Hazard Index	Utilisation
TSS	0.4	0.5(0.5)=0.25	0.5(0.5)=0.25	0.90	0.8	1.13
Metals	0.4	0.5(0.5)=0.25	0.5(0.6)=0.30	0.95	0.8	1.19
Hydrocarbons	0.4	0.5(0.6)=0.30	0.5(0.6)=0.30	1.00	0.9	1.11

During construction phase, temporary silts fences will be installed, providing an additional treatment stage of water filtration.

7 Hydraulic Assessment

A preliminary runoff and attenuation calculation for the compound has been undertaken using calculation sheet based on HR Wallingford online design tool available from:

https://www.uksuds.com/tools/greenfield-runoff-rate-estimation

The inputs taken have been assumed as "worst case" and as such has determined the maximum drainage component extents required for the project. This includes assuming all permanent infrastructure (other than the access track) has an asphalt surface, and that drainage by infiltration is not possible.

A detailed drainage design will be performed following the ground investigation and compound earthing design (to determine surface finishes).

All methods and inputs are taken in accordance with the relevant guidance documents provided in Section 2.

7.1 Greenfield Peak Runoff Rates from Site

Current and future greenfield runoff rates for the development have been estimated using the FEH Method. Using the flood estimation handbook web service, the site-specific parameters have been established:

- Standard average annual rainfall between 1941 – 1970 (SAAR): 696mm;
- Total drained area: 0.83ha;
- M5-60 rainfall depth: 14mm;
- Ratio M5-60 / M5-2day: 0.30.

Total drained area is defined as the catchment area for the attenuation basin, which comprises the area inside the compound (0.83ha). The extent of this area is shown on the Infrastructure Layout in ***Appendix A***.

Refer to ***Appendix B*** for the Q_{med} design tool calculation summary.

The peak runoff rate calculated for a Q_{med} (1 in 2) rainfall event is 2.71 l/s. It is proposed to match this discharge rate through use of a flow control device installed in a manhole positioned immediately downstream of the basin.

7.2 Attenuation Storage Required Post Development

The surface water storage volume estimation tool uses a storage assessment method developed by HR Wallingford based on correlations between storage requirements and hydrological and hydraulic characteristics of sites.

Attenuation storage will be provided to accommodate the peak runoff rate calculated up to the critical 1 in 200 storm plus a 39% allowance for climate change. To mitigate ground stability risk and slip / trip risk, basin slopes are limited to 1:3.

Refer to ***Appendix B*** for the storage volume calculation summary.

The calculation described in Section 6.1 indicates allowable discharge from the basin to be 2.71 l/s, however in accordance with Angus council Technical Guidance for Developers and Regulators: Flood Risk and Surface Water Drainage Requirements, the basin is set to the minimum practical rate of 3 l/s.

The catchment area for the basin is defined as the compound area with an approximate area = 0.83ha. All the catchment area is considered as impermeable area and characteristics are considered as worst case, providing a conservatively high coefficient.

The attention volume calculated based on the above criteria is approximately 650m^3. Initial assessment has been carried out to prove this volume can be accommodated within the site boundary. The attenuation volume should be considered a maximum volume, this assumes that all permanent infrastructure (other than the access track) has an asphalt surface and that drainage by infiltration methods is not possible.

As per Angus Council Technical Guidance for Developers and Regulators: Flood Risk and Surface Water Drainage Requirements, any proposed attenuation basin is to be able to empty within 24 to 48 hours.

In the case of a critical 1 in 30-year event the storage volume calculation included in ***Appendix B***; it can be observed that for the 36 hour 30-year return period storm, a maximum attenuation volume of 342m^3 is required. Based on an outfall rate of 3 l/s, 342m^3 would take approximately 31.6 hours to drain completely which is within the 24 to 48 hours emptying requirement included in the Angus Council guidance.

8 Operation and Maintenance Requirements

All surface water drainage and pollution control features associated with the site will remain private and will be maintained by the site operator.

The following section outlines the proposed maintenance for the various aspects of the drainage system. If necessary, these outline maintenance proposals will be refined when the site is operational to suit specific conditions.

A maintenance record log will be maintained for all maintenance work carried out. Where problems persist on each six-monthly inspection, advice will be sought from the SuDS designer on an alternative drainage solution.

8.1 Discharge Pipe & Filter Drain

The anticipated maintenance plan for the attenuation basin discharge pipe is outlined in Table 2.

Table 2 – Typical Discharge Pipe Operation and Maintenance Requirements

Discharge Pipe Maintenance Schedule	
Maintenance Action	**Minimum Frequency**
Inspect manhole / pipe. Where pipe has become clogged with silt, the pipe will be cleared out	Half yearly
Remove litter and debris	Half yearly
Inspect inlets and outlets for blockages, and clear (if required)	Half yearly

8.2 Infiltration / Attenuation Basin

The anticipated maintenance plan for the basin at the site is outlined in Table 3.

Table 3 – Typical Basin Operation and Maintenance Requirements

Basin Maintenance Schedule	
Maintenance Action	**Minimum Frequency**
Remove litter and debris	Half yearly
Inspect inlets and outlets for blockages, and clear (if required).	Half yearly
Inspect inlets and outlets for noticeable effects of erosion, suitable erosion protection measures such as reno-mattress or placement of large stones (>150mm) to dissipate water energy levels will be installed at the area affected.	Half yearly
Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies	Half yearly
Reseed areas of poor vegetation growth, alter plant types to better suit conditions (if required).	As required, or if bare soil is exposed over 10% or more of the basin treatment area

9 Conclusion

A flood risk assessment has been undertaken across the site. The site has been deemed at low risk of flooding.

An assessment of the drainage options has also been undertaken, and it has been concluded that drainage by infiltration is unlikely to be a viable option. As such, the current proposal is the drain the site via an attenuation basin, with a restricted discharge rate into the River South Esk. Infiltration testing will be undertaken on site prior to detailed design, and should acceptable infiltration rates be found, an infiltration solution will be adopted during detailed design.

The required attenuation volume has been calculated as approximately 650m^3. This should be considered a maximum volume, based on the assumption that all permanent infrastructure (other than the access track) has an asphalt surface and that drainage by infiltration methods is not possible.

A site investigation, 3D earthworks design, earthing design, and a further assessment of the proposed discharge will be undertaken to inform the detailed design of the site drainage.

The drainage strategy proposed will provide sufficient water quality treatment as demonstrated using the Simple Index Approach.

Appendix A Project Drawings

A.1 Infrastructure Layout – 05104-RES-LAY-DR-PT-001

A.2 Typical Drainage Details – 05104-RES-DRN-DR-CE-001

A.3 Site Location – 05104-RES-MAP-DR-XX-001

A.4 Post Development Extreme Event Flow Path – 05104-RES-DRN-DR-CE-003

A.5 Pre-development overland flow path – 05104-RES-DRN-DR-CE-002

Appendix B Calculations

B.1 Greenfield Runoff Calculations – 05104-6919602

B.2 Attenuation Storage Calculations - 05104-6837999

Appendix C Topographical Survey

C.1 Topographic Survey

Appendix D Borehole Records

D.1 Borehole NO65NE13019-38-1

Appendix E Compliance Documents

E.1 Self-Certification

E.2 Confirmation of future maintenance of surface water drainage/SuDS

E.3 Drainage Assessment Checklist